Observing Systems Simulation Experiments

The New Nature Run and Collaborations

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The current NCEP system has shown that OSSEs can provide critical information for assessing observational data impacts.

The results also showed that theoretical explanations will not be satisfactory when designing future observing systems.

OSSE will be also used to design an ensemble system.
Evaluation of Targeted observations

Costs for OSSE are a small fraction compared to actual observing systems.

OSSEs are very labor intensive project.

Nature Run: Serves as a "true" atmosphere for OSSEs

Preparation of the nature run consumes a significant amount of resources.
If different nature runs are used the results can not be compared.
Using many nature runs will delay the delivery of the OSSE results

One or two good new nature runs, which will be used by many OSSEs, are needed.

The simulated data is shared
The results are compared

Forecast runs, forced by daily SST and ICE, will be used for the Nature run.

Analyses are forced by observations and has a jump in time evolution.
Analyses are affected by the data assimilation scheme.
Forecast runs allow frequent sampling.
Analyses lack dynamical consistency.

New Nature Run by ECMWF

Based on Recommendations by
JCSDA, NCEP, GMAO, GLA, SIVO
SWA, NESDIS, ESRL

Low resolution Nature Run (L-NR)

Spectral resolution : T511 Vertical level: L91
3 hourly dumps
13 month period starting spring 2005
Daily SST and ICE (Provided by NCEP)

Intensive diagnostics for participating institutes to select one or two of the most interesting periods

High resolution Nature Run for selected period

T799 resolution, 91 levels, one hourly dump
Get initial condition from L-NR
Two three week periods

Archived in MARS system

On the THORPEX server at ECMWF
Accessed by external users
US copies for designated users

T511L91 run was completed; evaluation and data processing is in progress

Sample data is available from
http://www.emc.ncep.noaa.gov.research/osse

Extended international collaboration within the Meteorological community is essential for timely and reliable OSSEs

JCSDA , NCEP, NESDIS,NASA, ESRL
ECMWF, ESA, EUMETSAT
THORPEX, IPO
Operational Test Center OTC – Joint THORPEX/JCSDA

Simulation of the data must be done using model levels and full resolution.

Pressure level data will be available for diagnostics and evaluation only.

Possible limited isentropic level data may become available.

Grib2 and Bufr formats will be used

Contacts for the New Nature Run

ECMWF
Erik Andersson
NCEP
Michiko Masutani
NASA/GSFC
Lars-Peter Riishojgaard(GMAO),
Oreste Reale(GLA)
Joe Terry (SIVO)
JCSDA
John LeMarshall
NESDIS
Thomas J. Kleespies
SWA
Steven Greco
ESRL
Tom Schlatter
THORPEX
Pierre Gauthier(DAOS)
David Person(USA)
Zoltan Toth (GIFS)

2005-2006 was selected.
Summer 2005 was active
Winter 2005-2006: many weather events
Most recent year is preferable

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Authors and Contributors

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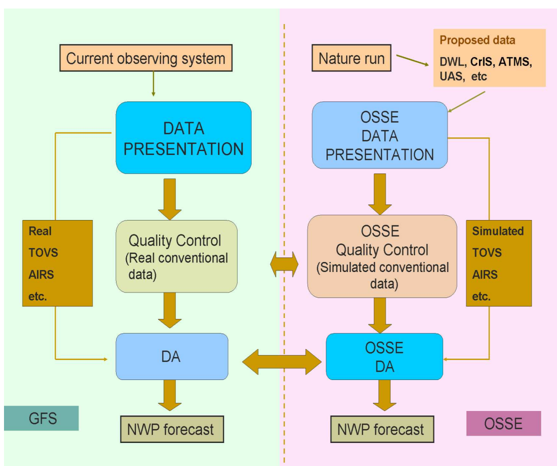
The Role of JCSDA in OSSEs

Joint Center for Satellite Data Assimilation (JCSDA) Mission
Accelerate and improve the quantitative use of research and operational satellite data in weather and climate analysis and prediction models

- As a result **a key program element** for the Center is the conduct of OSSEs for advanced satellite sensors to be used for weather and climate (environmental) analysis and prediction.
- Instruments being currently assessed for such experiments are the CrIS, ATMS, GOES-R/GIFTS and the HyMS* – P and G%.

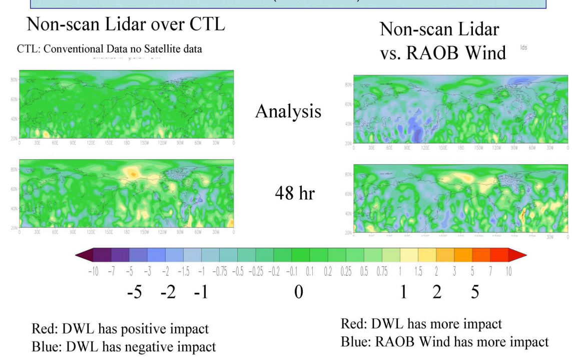
* HyMS Hyperspectral Microwave Sounder
% P- Polar, G Geostationary

Parallel system between operational DA and OSSEs to speed up the performance



Non-Scan Lidar vs. RAOB Wind T170 (Feb13- Feb20)

Non scan lidar showed minimum impact over RAOB wind



Non scan lidar has more impact over ocean and RAOB has mode impact over land
Impact increase in forecast fields

Adaptive Targeting OSSE for Planning a Space-Based Doppler Wind LIDAR

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Background and Methodology

Observing System Simulation Experiments (OSSEs) provide a unique methodology for obtaining quantitative evaluations useful in designing advanced meteorological observing systems. The procedure is based on a simulated atmosphere derived from a high resolution state of the art numerical weather prediction model which is run for a rather long period (i.e., a month or more). Idealized observations are synthesized from the simulated nature to resemble observations found in the real world. Imaginary observations from prospective instruments can also be synthesized and then used in assimilation/forecast experiments to gauge the potential impact of such instruments, if they were to be developed.

When using current technology to develop LIDAR wind measurement (DWL) instruments, power is a major limiting factor in producing highly accurate observations. One important question to be considered by designers is whether very accurate (high power) observations over limited areas (targets) will be more cost effective than observing more of the globe with significantly less accurate (low power) observations.

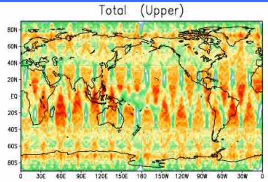
Experiments described here were conducted to evaluate the feasibility of gaining useful information from the 10 percent operation of a very accurate LIDAR instrument installed on a polar orbiting platform, given an ideal method of targeting areas having the largest background wind errors. Maximum forecast errors are determined by a four dimensional comparison of simulated nature (the "truth") with the assimilating forecast within each orbital observing period, during a one month assimilation.

Roughly 10% of the observations in each orbit are thus identified for assimilation, with the maximum error located in the center of the 10% segment. Forecast results from the adaptive targeting were compared with five non-adaptive DWL samplings, including 100%, 50% (uniform), 10% (uniform), 10% (fixed ocean), and 0% (a control using none of the very accurate high power DWL observations).

Data Diagrams for Adaptive Targeting Experiments

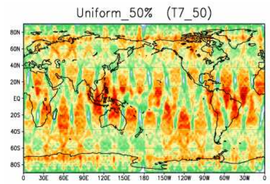
Data selection Cases

(200mb Feb13 - Mar 6 average)



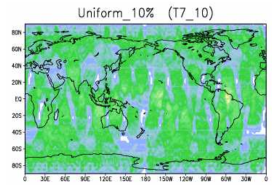
100% Upper Level

Doubled contour



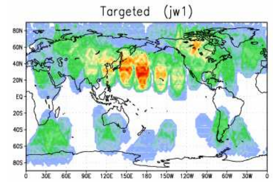
50% Upper Level

regular sampling



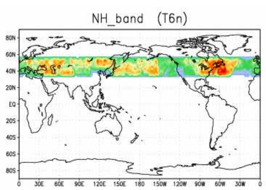
10% Upper Level

Regular Sampling



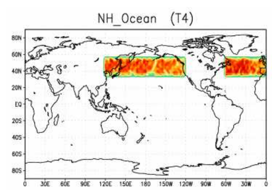
10% Upper Level Adaptive sampling

(based on the difference between first guess and NR, three minutes of a segment are chosen – the other 81 minutes are discarded)



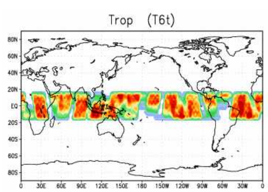
10% Upper Level

NH band

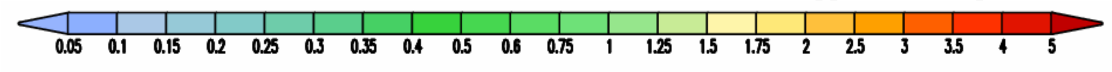


10% Upper Level

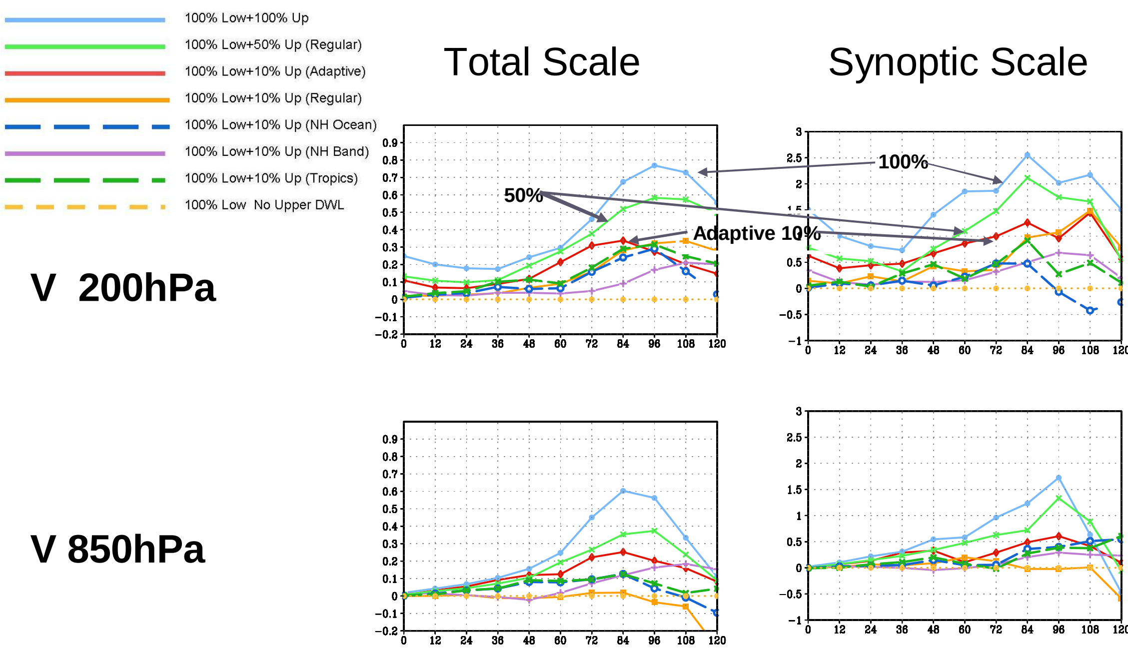
NH Ocean

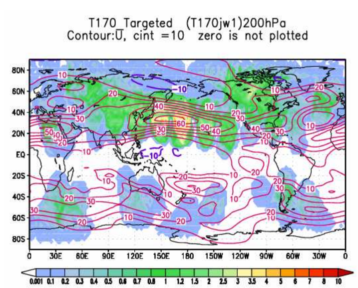


10% Upper Level tropics

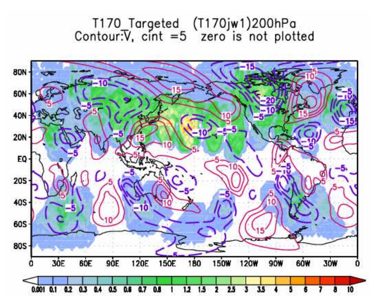


NH Three Day AC Forecast Scores





Target in Jet region



A target in North America and Eurasia associated with northerly wind

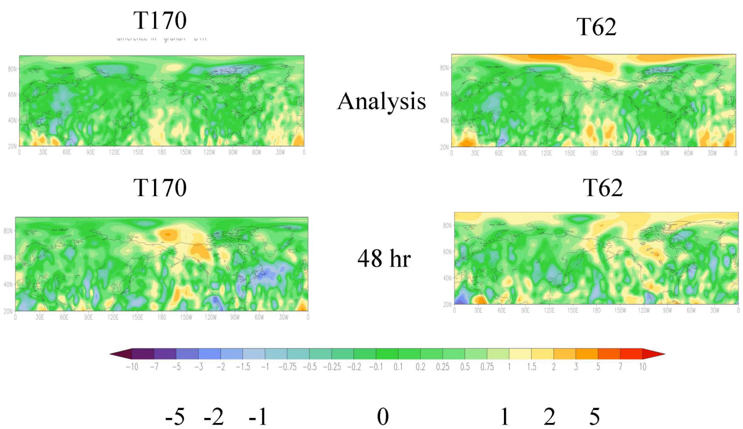
Summary of Targeting Tests' Results

- 10% DWL without targeting does not produce much impact (requires at least 50% of the data)
- A perfect 10% adaptive targeted DWL had a 3 day forecast skill similar to the 50% DWL experiment
- Target regions correspond well with the Northern Hemisphere jet stream and extend to snow covered land
- Fixed area targeting did not show a better impact than uniform sampling.
- 10% targeted DWL improves the low level wind forecast after 48 hrs

By selecting a target efficiently, the data impact could increase to the equivalent of as much as 5 times the data in Northern Hemisphere Winter.

Future work:
Targets based on an ensemble
Higher resolution experiments
Longer times and different seasons using anew nature run

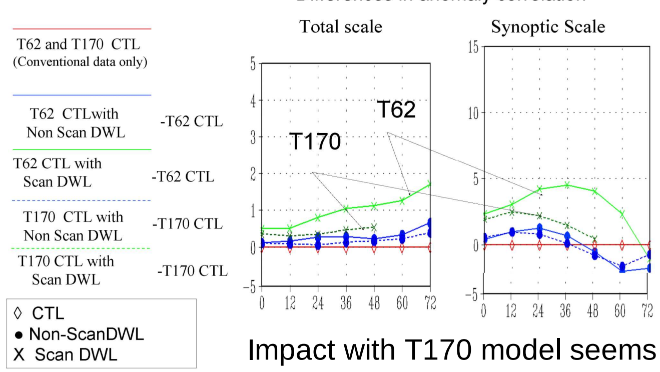
Impact of DWL with Scanning T170 vs. T62



Data Impact in T62 vs. T170

V200

Differences in anomaly correlation

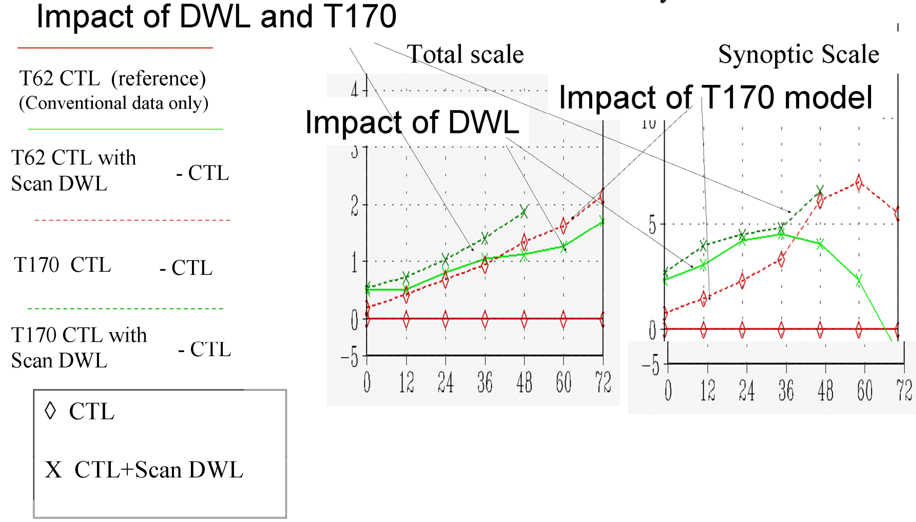


Impact with T170 model seems less than with T62 model

Data Impact of scan DWL vs. T170

200 mb V

Differences in anomaly correlation

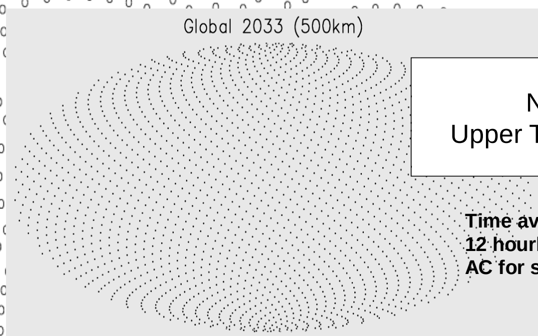


Apparent data impact is less with a high resolution model (T170 or better) because the guess is already good. However, improvement from the new data becomes more robust with a high resolution model.

At planetary scales T170 is better than adding DWL with scan

At smaller scales adding DWL with scan is more important than having a T170 model

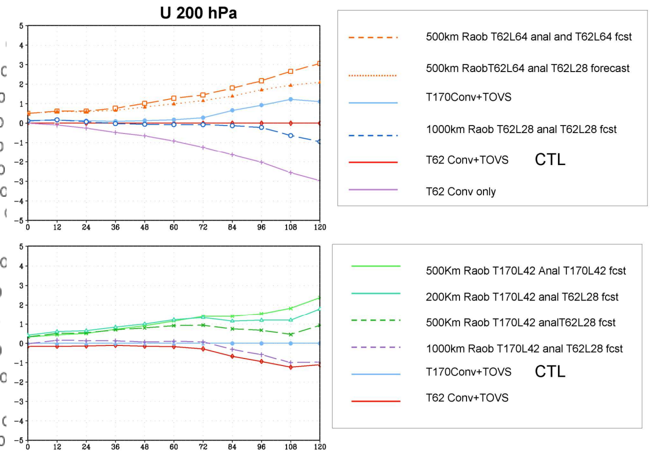
OSSEs with Uniform coverage data



N. Hem. Forecast Skill
Upper Tropospheric Wind & Temp.

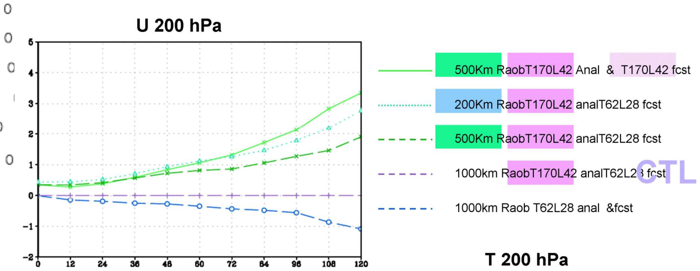
Time averaged from Feb13-Feb28
12 hourly sampling
AC for synoptic scale is presented

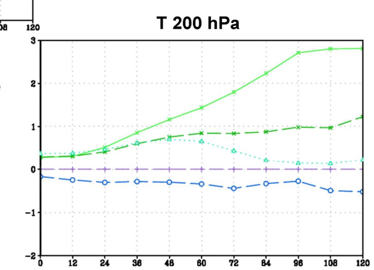
Fibonacci Grid used in the uniform data coverage OSSE
25mb vertical interval



Anomaly Correlation %

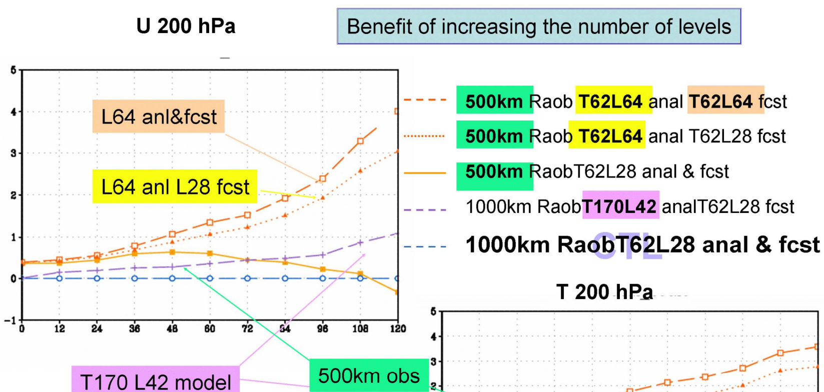
AC:the difference from CTL

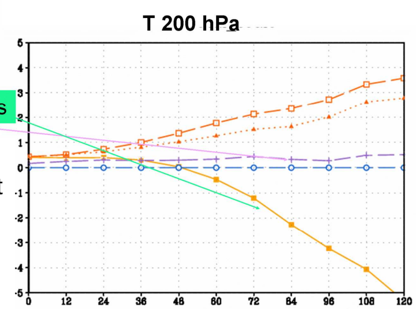




Using T170 model 500km obs help good forecasts.

Even for T170 model 200km obs may make worse forecast.





High density observations give a better analysis but could cause a poor forecast

Increasing the vertical resolution was important when using high density observations

Too much data will not make good forecasts.

Sufficient vertical resolution in the forecast model is critical.